

**AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims 1-38. (Cancelled)

39. (New) A method for determining the morphology and motility of a population of cells in vitro including the steps:

- (a)(i) capturing a first frame of image data of said population and identifying a part or parts of the image data corresponding to a cell or cells of interest;
- (a)(ii) capturing a second frame of image data of said population and identifying a part or parts of the image data corresponding to a cell or cells of interest;
- (b)(i) determining the characteristic morphology of the cell or cells of interest from the first and/or second frame;
- (c)(i) tracking the cell or cells of interest by identifying each cell of interest by its characteristic morphology and determining the relative displacement, in the second frame compared to the first frame, of said cell or cells of interest.

40. (New) A method according to claim 39 wherein the first and second frames are adjacent frames in a series of more than two frames of image data captured of said population, the method further including, for each frame of said series, the steps:

- (a)(iii) identifying a part or parts of said image data corresponding to the cell or cells of interest;
- (b) (ii) determining the characteristic morphology of said cell or cells identified in step (a)(iii);
- (c)(ii) tracking the cell or cells of interest by identifying each cell of interest by its characteristic morphology and determining the relative displacement, in said frame compared to the previous frame in said series, of said cell or cells of interest.

41. (New) A method according to claim 39 including the step of determining a value for the motility of the cell or cells of interest, based on the relative displacement of the cell or cells of interest.

42. (New) A method according to claim 39 including the step of determining the amount or relative amount of the population of cells having a motility at or above a threshold motility value.

43. (New) A method according to claim 42 including the step of classifying the cell or cells of step (b)(i) or step (b)(ii) as morphologically normal or morphologically abnormal.

44. (New) A method according to claim 43 including the step of determining the amount or relative amount of the population of cells being morphologically normal.

45. (New) A method according to claim 43 including the step of determining the amount or relative amount of the population of cells:

being morphologically normal, and

having a motility at or above a threshold motility value.

46. (New) A method according to claim 39 for carrying out a first determination of morphology and motility on a first area of a sample of cells, the method including the step of carrying out a second and, optionally, further, determinations of morphology and motility on a second and, optionally, further, areas of the sample.

47. (New) A method of processing image data captured from a population of cells in vitro in order to determine the morphology and motility of the cells, the image data including a first frame of image data of said population and a second frame of image data of said population, the method including the steps:

(i) determining the characteristic morphology of the cell or cells of interest from the first and/or second frame; and

(ii) tracking the cell or cells of interest by identifying each cell of interest by its characteristic morphology and determining the relative displacement, in the second frame compared to the first frame, of said cell or cells of interest.

48. (New) A method according to claim 47 wherein the first frame of image data is processed to identify illumination intensity distributions of interest having one of a plurality of characteristic profiles.

49. (New) A method according to claim 48 wherein one of the characteristic profiles is a first characteristic profile having a centre point of a relatively high intensity surrounded by a substantially symmetrical gradual reduction in intensity.

50. (New) A method according to claim 48 wherein the parts of the image data corresponding to the illumination intensity distributions of interest are further processed to identify cell perimeter features surrounding one or more of said illumination intensity distributions of interest.

51. (New) A method according to claim 48 wherein an object of interest is identified, the method further including the step of determining one or more dimensions or relative dimensions of an object.

52. (New) A method according to claim 51 wherein said dimensions or relative dimensions are compared to one or more predetermined ranges of corresponding dimensions or relative dimensions.

53. (New) A method according to claim 39 further including the step of determining whether said object is a cell to be tracked or not and:

if said object is a cell to be tracked, assigning a tracking identity to it; or

if said object is not a cell to be tracked, assigning a residual object identity to it.

54. (New) A method according to claim 39 further including the step of determining a characteristic morphological value for said cell to be tracked.

55. (New) A method according to claim 39 repeated in order to identify all cells to be tracked and all objects not to be tracked in a frame of image data.

56. (New) A method according to claim 55 repeated for the second and/or subsequent frames.

57. (New) A method according to claim 39 wherein when the tracks of two cells of interest intersect, the cells and their tracks are identified before and after the intersection by their characteristic morphologies.

58. (New) A method according to claim 39 wherein when a cell of interest is identified in one frame and not identified in the next frame, the cell being identified in a subsequent frame, the method further includes the steps of calculating tracking data to connect the track of the cell through the frames.

59. (New) A method according to claim 39 further including the step of determining a motility characteristic for a tracked cell.

60. (New) A method according to claim 59 further including determining an overall figure of merit for the sample indicative of the number or proportion of morphologically normal cells with normal motility.

61. (New) A method according to claim 39 wherein image capture is performed using digital imaging means providing a frame resolution or an effective frame resolution of at least  $0.5 \times 10^6$  pixels.

62. (New) A method according to claim 61 wherein the rate of image capture for a series of frames is at least 20 Hz.

63. (New) A method according to claim 39 wherein the cell or cells of interest are spermatozoa.

64. (New) A method according to claim 63 wherein the cell or cells of interest are human spermatozoa.

65. (New) A method according to claim 39 further including the step of diagnosis based on the determination of the morphology and motility of the population of cells in vitro.

66. (New) A method according to claim 65 wherein the step of diagnosis is based on a value of the amount or relative amount of cells categorised as morphologically normal and having a motility at or above a threshold motility value.

67. (New) Apparatus for determining the morphology and motility of a population of cells in vitro, the apparatus including:

imaging means for capturing first and second frames of image data of said population and identifying a part or parts of the image data corresponding to a cell or cells of interest;

computation means for determining the characteristic morphology of the cell or cells of interest from the first and/or second frame, tracking the cell or cells of interest by identifying each cell of interest by its characteristic morphology and determining the relative displacement, in the second frame compared to the first frame, of said cell or cells of interest.

68. (New) Apparatus according to claim 67 wherein the imaging means is digital imaging means providing a frame resolution or an effective frame resolution of at least  $0.5 \times 10^6$  pixels.

69. (New) Apparatus according to claim 68 wherein the imaging means is arranged to capture a series of frames at a rate of at least 20 Hz.

70. (New) Apparatus according to claim 67 wherein the imaging means includes phase contrast optics.

71. (New) A computer system operatively configured to carry out the method according to claim 39.

72. (New) Computer programming code for operatively configuring a computer system to carry out the method according to claim 39.

73. (New) A data carrier having recorded on it computer programming code according to claim 72.